Sparticle Masses

First we discuss the SUSY partners for the gauge and Higgs particles — the gauginos & higgsinos these are fermions. The we consider the scalar partners to the matter fermions, the squark & slepton fields. There are 90 real scalar squark & slepton fields while only 16 types of fermions. Since electric charge and color are unbroken, fields with these same values (and spin) will mix.

Gluinos: $\tilde{G}^m_\alpha, \bar{\tilde{G}}^m_{\dot\alpha}$ are the fermionic gaugino partners of the gluons. They are the only octet fermion and hence do not mix (SU(3)) with any other fermion so they are a mass eigenstate. Their mass is given by the soft SUSY breaking terms as:

$$\mathcal{L}_{\not{S}ym} \subset \frac{1}{2} M_3 \tilde{G}^m \tilde{G}^m + \frac{1}{2} \bar{M}_3 \bar{\tilde{G}}^m \bar{\tilde{G}}^m$$

Note: M_3 can be chosen real by a phase re-definition of $\tilde{G}$: $\tilde{G} \to e^{-i\phi}\tilde{G}$; $\bar{\tilde{G}} \to e^{+i\phi}\bar{\tilde{G}}$ & $M_3 = |M_3| e^{i\theta}$ So $\phi = \theta$ cancels the M_3 phase. The squark fields can be re-defined as well to absorb this phase in the $\sqrt{2} g_3 \tilde{\phi}^\dagger_F (\tilde{G}^m \frac{\lambda^m}{2}) \psi_F$, etc. couplings. It is convention to make M_3 Real and not M_1 or M_2 — since the squark phase is fixed — only one gaugino mass can be made real.

So

$$\mathcal{L}_{\substack{\text{gluino}\\ \text{mass}}} = \frac{1}{2} M_3 \left[\tilde{G}^m \tilde{G}^m + \bar{\tilde{G}}^m \bar{\tilde{G}}^m \right]$$

Charginos & Neutralinos : $SU(2) \times U(1) \to U(1)_{em}$ results in states with the same electric charge and color (and spin) mixing.

The neutral Higgsinos and neutral gauginos will mix to form neutral mass eigenstates

Neutral Higgsinos : $\tilde{H}_u^0, \tilde{H}_d^0$ & $\bar{\tilde{H}}_u^0, \bar{\tilde{H}}_d^0$

Neutral Gauginos : $\tilde{A}^3, \tilde{B}$ & $\bar{\tilde{A}}^3, \bar{\tilde{B}}$

The corresponding mass terms comes from several sources:

soft SUSY Breaking 1) $\mathcal{L}_{\not{S}YM} \supset \frac{1}{2} M_1 \tilde{B}^2 + \frac{1}{2} \bar{M}_1 \bar{\tilde{B}}^2 + \frac{1}{2} M_2 \tilde{A}^{3\,2} + \frac{1}{2} \bar{M}_3 \bar{\tilde{A}}^{3\,2}$

Superpotential 2) $\int d^2\theta\, W + \int d^2\bar{\theta}\, \bar{W} \supset \int d^4x \left[-4\mu \tilde{H}_u^0 \tilde{H}_d^0 - 4\bar{\mu} \bar{\tilde{H}}_u^0 \bar{\tilde{H}}_d^0 \right]$

Kähler Potential 3) $\mathcal{L}_K \supset \sqrt{2}\, g_1 \Big[\frac{1}{2} \frac{v_u}{\sqrt{2}} \tilde{B} \tilde{H}_u^0 + \frac{1}{2} \frac{v_u}{\sqrt{2}} \bar{\tilde{H}}_u^0 \bar{\tilde{B}}$

$\qquad\qquad - \frac{1}{2} \frac{v_d}{\sqrt{2}} \tilde{B} \tilde{H}_d^0 - \frac{1}{2} \frac{v_d}{\sqrt{2}} \bar{\tilde{H}}_d^0 \bar{\tilde{B}} \Big]$